

ART. XIII.—*Phreatoicoides*, a new Genus of Fresh-water  
*Isopoda*.

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(With Plates X., XI., XII.).

[Read 14th September, 1899.]

The specimen under consideration was found by the writer during an excursion in the forest district of Thorpdale, Gippsland; and was taken whilst searching logs of wood dragged from out of a small tributary of the Narracan running through a virgin fern-gully. The water was flowing somewhat rapidly, and it is surprising that, being unable to swim, and also being devoid of eyes, this animal should choose such a situation; however I only met with two or three specimens in the swift running water, and these were taken from crevices within logs lying in the water, and they had possibly been washed down from places where the stream, through the damming back by fallen forest debris, had widened out to form shallow gently running areas, for, on searching in such localities, I found them somewhat numerous and generally in little colonies. From one rotting tree-fern trunk, lying in such a place, on cutting into the fibres, I took as many as nine specimens within an area of six inches.

On examination it has proved to be a form of considerable biological interest, and I desire to record my debt of gratitude to Professor Baldwin Spencer for affording me laboratory facilities, and for his personal interest and help in my work.

From the following description it will be seen to be an Isopod, and, on account of fundamental differences in the pleon from any recorded species, it appears necessary to form a new genus, for which, because of its close affinity to *Phreatoicus*, Chilton,<sup>1</sup> and

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<sup>1</sup> In 1882 Dr. Chilton first described the genus in the Trans. N.Z. Institute, vol. xv., p. 89. In 1891 he described a N.S.W. species and considered the position of the genus in the Records Aust. Museum Sydney, vol. i., p. 149, and in the Trans. Linn. Soc. London, May, 1894, he published an important paper in which he slightly amended his generic description, and gave full particulars and drawings of the two New Zealand species, compared them with their probable affinities, and gave other important details, as well as debated some interesting biological questions connected with the Theory of Descent.

*Phreatoicopsis*, Spencer and Hall,<sup>1</sup> I propose the name of *Phreatoicoides*.

A striking feature about it is that, although inhabiting surface waters, it is blind; and on examining serial sections through the head and brain, I failed to find any definite optic lobes, such as occur in *Phreatoicopsis terricola*, which I prepared for comparison. This points to its near ancestors inhabiting caves or subterranean waters. The New Zealand forms *Phreatoicus typicus* and *P. assimilis*, from subterranean waters, are blind; *P. australis* and *P. terricola*, both inhabiting surface waters, have functioning eyes, the former is recorded from Mount Kosciusko, N. S. W., near the north-eastern border of Victoria, at an elevation of 6,000ft. and the latter from forest country near Colac, in the western district of Victoria. The species under review is from the eastern district of Victoria.<sup>2</sup>

Another noteworthy characteristic of this species is the apparent dimorphism in the males. The only outward difference that I have observed is in the ultimate and penultimate joints of the first pereopods, which together act as a clasping "hand." The two forms are shown in Figs. 9 and 10. In the one form it is similar to that of all females, but in the other the propodos is very much larger, and the dactylos longer and more curved, showing the peculiarity of the males of the hitherto described species of *Phreatoicus* and *Phreatoicopsis*. The two forms of males noted in the present species are evidently not due to maturity alone, for in Fig. 9 which was drawn from a male of 17 mm. in length, the normal form is shown, whereas in Fig. 10, the male measured only 9 mm. long, and shows the sexual differentiation in the enlarged propodos as described by Chilton, and Spencer and Hall. And further, amongst a considerable number collected I only found three males with the enlarged propodos, none of which were longer than 12 mm. It seems reasonable therefore to consider that in this species mature males exist in two forms.

It is well known that an apparent dimorphism exists in some few widely separate orders of Crustacea, but whether permanent,

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<sup>1</sup> Proc. Roy. Soc. Victoria, vol. ix. p. 12.

<sup>2</sup> Since writing the above I find that Mr. J. M. Thomson has recorded *P. australis* from pools on Mount Wellington (4,000ft.), Tasmania. Proc. Royal Soc. Tasmania for 1892, p. 76.

or only changing upon the casting of the skin previously to the breeding season and afterwards alternating back again at the next moult, was not known until Faxon kept alive and bred in confinement the fresh-water cray-fish of the United States, *Cambarus rusticans*, Gerard, when he found that the two stages are not permanent "but simply alternating periods in the life of the individual, the 'first form' (so called by Dr. Hagan) being assumed during the pairing season, the 'second form,' during the intervals between the pairing season."<sup>1</sup>

I consider it probable that in the species now under consideration a similar alternation in the males takes place, and I shall describe the structure of the two forms later under the head of Normal and Hymeneal.

Living in the same water as the present species were large numbers of an Amphipod, which, upon superficial examination, appears to be a closely akin genus to *Gammarus*. Also, from a little pool within a few yards from the streamlet, I took another Amphipod, possibly a *Niphargus*, and a small Isopod, of the family *Asellidae*. These I hope to determine later.

In the following description I have adhered as closely as possible to the arrangement and nomenclature of Chilton, and Spencer and Hall.

#### Phreatoicoides, n.g.

Body linear, subcylindrical. Upper antennæ short, lower long, with flagellum. Mandibles with an appendage. First pair of legs subchelate, others simple. The legs are divided into an anterior series of four and a posterior series of three. Pleon short, slightly laterally compressed, of six distinct segments, last joined to telson. Pleopoda exposed, foliaceous. Uropoda biramous, styliform. Telson large, sharply truncate.

#### *Phreatoicoides gracilis*, n. sp.

*Specific diagnosis*.—Body slender, greatly elongated, long flexuose setæ scattered sparsely over surface. Pleura of pleon not produced, their inferior margins sparsely fringed with small

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<sup>1</sup> Faxon, "On the so called Dimorphism in the genus *Cambarus*." *American Journal of Science*, vol. xxvii, 1884.

spinules. Eyes not formed. Taking cephalon and pereion as 100, pleon and telson measures  $\frac{36}{100}$ . Fifth segment of pleon about the same length as the anterior four. Sixth segment very powerful, deeper than anterior ones, narrowly united to fifth segment, measures with telson about the same length as the anterior five segments. Upper antennæ slightly less in length than peduncle of lower antennæ. Lower antennæ about two-thirds of the length of the body; peduncle of five joints, first two short, subequal, remaining three gradually increasing in length, the last being as long as the first three combined. Lower lip two-lobed. Extremity of inner lobe of first maxilla clothed with three plumose setæ, extremity of outer lobe truncate, and bearing about nine spiniform setæ. Legs long, slender. First pair (gnathopods) subchelate, largely developed in some males. Telson abruptly truncate. Uropoda with peduncle, stretching behind the telson; rami as long as peduncle, inner one curved inwards.

*Colour*.—Creamy-white.

*Length*.—9–20 mm.

*Habitat*.—Fresh-water runnel, Thorpdale, Gippsland.

#### DETAILED DESCRIPTION.

The following detailed description is mainly taken from a male specimen 17 mm. in length, and a gravid female of 12 mm. in length.

*Body* (Plate X., Fig. I).—The largest specimen I have measures 20 mm., and the smallest 8 mm. A female with eggs in the incubatory pouch measures 12 mm.<sup>1</sup>

The body is very slender, and, within narrow limits, uniform in width and depth throughout, except for being deeply cleft ventrally at the junction of the fifth and sixth segments of the pleon, which allows the posterior segment to be flexed acutely downwards. This segment with its uropods acts as a powerful lever to propel the animal forwards.

The dorsal surface is very convex and the ventral surface slightly so.

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<sup>1</sup> In the lithograph, a mistake has been made in the terminal segment, where the articulation of the uropod is made to appear as if with the anterior margin, instead of with the postero-distal margin. Fig. 14 shows it correctly.

The depth through the body measures about 1 mm.

*The surface* of the whole body is smooth, with long flexuose setæ disposed irregularly over the dorsal and lateral surfaces. At the extreme posterior margin of the head, and of each segment of the pereion, there is a single row of fine setæ pointing backwards. Along the inferior margin of each segment, from the first to the penultimate, short stout setæ are sparsely disposed, while at the posterior inferior angles of each segment of the pereion, except the last, there is a tuft of stout setæ pointing hindward. Upon the epimera also there are a few scattered fine setæ pointing downward.

*Head.*—The head is longer than the following segment, and also deeper and somewhat wider. The dorsal surface is very convex and curves downwards anteriorly, making the outline, as seen in a lateral view, subtriangular. The anterior margin as seen from above is deeply concave behind the bases of the upper antennæ. The inferior margin is nearly straight for the anterior two-thirds, it is then deflected downwards. At the anterior angle there is a notch above the maxillary palp. Equidistant between the dorsal and ventral surfaces the posterior margin is deeply cut forwards and then downwards to join the deflected posterior margin, so that a large triangular space is formed. At the apex of this triangle a depression runs forward and upward towards the dorsal surface. There is no trace of any eyes.

*Pereon.*—The *first segment* of the pereon is only about two-thirds as long as the second. The antero-inferior angle is produced forward to occupy the triangular space in the postero-inferior angle of the head. The inferior margin is straight with the exception of the anterior extremity which is produced downward somewhat. The *second, third and fourth* segments are subequal; the antero-inferior angles of each are rounded off, and the inferior margins slightly concave above the epimera. The *fifth and sixth* segments are subequal and shorter than the preceding one, and the *seventh* shorter than the sixth, being of similar length to the first. The inferior margins of each of these last three segments is deeply emarginate above the epimera, which are situated at the posterior extremity of the segments.

*Pleon.*—The *four first segments* of the pleon are subequal, and measure conjointly the length of the penultimate segment of the

pereion. They are somewhat laterally compressed, and to a very slight extent deeper than the preceding ones, caused by the very narrow pleura. Their inferior margins are convex and bordered by a few spinules. The *fifth* segment is three times longer than any of the preceding four. The dorsal surface curves downward somewhat hindward; its anterior margin is as deep as the preceding segment, but the inferior margin runs upward in a gradual ascent to nearly meet the dorsal surface, so that a very narrow joint is formed with the sixth segment. Its inferior margin is fringed like the preceding segments with scattered spinules. The *sixth segment* (Fig. 14) is completely coalesced with the telson, and measures nearly as long as the preceding five segments. The dorsal surface in lateral view is slightly convex, and in transverse section the sides are deeply arched downwards, and the ventral surface transversely concave. The middle and anterior portion is slightly wider than the posterior extremity, which terminates, a short distance behind the articulation of the basal joint of the uropods, in a widely gaping abruptly truncated telson, very similar in outline, except in the uropods, to *P. terricola* (S. and H.).<sup>1</sup> In lateral view the inferior margin, anteriorly to its insertion with the uropods is, for a short distance, nearly straight and bordered by five spinules; more anteriorly it ascends in a steep grade to its junction with the preceding segments, so that a triangular piece appears as if cut off from this, as also from the posterior end of the preceding segment. The wide space thus left allows of deep ventral flexion of the hind segment. At a distance of about two-thirds the length of the segment the inferior margin ascends vertically to nearly half the depth of the segment, and from this part the peduncle of the uropod of each side arises, which point directly hindward. The inferior margin, from the position of the insertion of the superior border of the peduncle to its termination, is somewhat convex in longitudinal view, and is about one-third the length of the segment. From the posterior dorsal angle of the telson a tuft of long fine spiniform setæ point upwards and hindward, and the posterior margin is sparsely fringed with short setæ.

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<sup>1</sup> *Loc. cit.*, p. 15.

*First Antennæ.*—The first or upper antennæ are short, scarcely reaching to the end of the peduncle of the second antennæ, and are divided into sometimes nine and sometimes ten joints. The first three form the peduncle, and show a slight difference to the succeeding ones; the *basal joint* is stouter and somewhat longer than the succeeding ones, and the upper margin is slightly concave; it is free from setæ. The *second* and *third* are subequal in length, but the second is somewhat stouter than the third; they are each studded with fine stiff outstanding setæ, and near the distal margin of each are a few very long fine setæ pointing distally. The succeeding joints, composing the *flagellum* are mostly with the exception of the penultimate and distal ones, subequal, and slightly shorter than the last joint of the peduncle, as well as being somewhat thinner. Near the distal margin of each is a series of a few short setæ pointing distally, and very occasionally, from any part of a joint, may arise a single “olfactory” and plumose seta, pointing directly outwards. The penultimate joint is about twice the length of any of the preceding ones, and has a number of setæ near the upper margin. The terminal joint is very short and bluntly pointed, and arising from its summit are tufts of setæ. The setæ are of three distinct kinds, viz., (*a*) so called “olfactory cylinders,” (*b*) delicately plumose or feathered setæ, and (*c*) long setæ, which, under high magnification, show the extremity to be cleft into three minute pieces, one of which is slightly swollen and rounded, and having a fine filament leaving it on one side; the other two pieces are pointed, and arched over the rounded piece. At a short distance from the end, there is the appearance of a transverse line. This latter form is situated on the distal margin of each joint. At the end of the last joint, the three kinds are found together.

*Second Antennæ.*—The second antennæ are about two-thirds the length of the body. The *peduncle* consists of five joints. The first two are short and subequal, the third as long as the previous two combined, and slightly curved, the fourth somewhat longer, being as long as the first three combined. Each of the joints is sparsely setose, while from the terminal margin of the fifth is a series of very long setæ and also a few from the under margins of the third and fourth. The *flagellum* is composed of about twenty-eight joints; the first is twice as long as each of the

succeeding six or seven; more distally they become gradually longer up to the penultimate, which is somewhat longer than the first. Each bears at its distal margin a circlet of short setæ. The terminal joint is short, and bears on its summit a few longer setæ.

*The Upper Lip* (Fig. 2).—The upper lip is large and strong, broader than long, and regularly rounded at its distal end. The extremity is not produced as in *P. australis*. The front margin is thickly fringed with fine setæ which also clothe the front inner surface.

*Mandibles* (Figs. 3 and 4).—The mandibles differ in no essential respect from *P. australis* and *P. terricola*. From their basal attachment, which is very wide, they project directly downward and curve inward. On each, at about half their length, a molar tubercle arises from the inner concave surface, and, when the mandibles are closed, the summit of one meets that of the other in the mid axis. The distal or lower half of each of the mandibles rapidly becomes attenuated, continuing downward and curving inward, at the same time twisting round somewhat hindward, to form at their apices the cutting teeth. These also meet together at the mid axis, but more ventrally than the molar tubercles. The anterior margin is somewhat convex; the hind margin gradually becomes narrower as it approaches the position of attachment of the molar tubercle, and is then sharply and deeply cut forward, and then continued downward to the distal extremity. The basal angular piece remaining at the base of the molar tubercle is densely clothed with short setæ. Near the basal attachment of each mandible and close to the anterior margin arises a three-jointed *palp*, which is directed forward and downward. (In the figures they do not lie in their normal position, the ends being displaced somewhat by the pressure of the cover slip used in examination). The first joint is short, the second three times longer, and the third slightly longer than the first. This joint has its upper margin convex and free from setæ, and on the under margin there is a double row of setæ, the first two or three distal ones being very long and incurved, but more proximally they gradually decrease in length. The second and first joints have their upper borders fringed with very short setæ, the under border of the first joint bears two or three



scattered setæ, and also on the under margin of the second joint there are about five very long straight setæ pointing downwards and forwards.

As in the other allied forms mentioned they differ somewhat from each other in the cutting edges, and other minor features.

The *left* mandible (Fig. 4) has the cutting edge composed of two rows of teeth, one on the inner side of the other; they are widely divided distally and united proximally. The outer one consists of four sharp strong teeth, and the inner one of four somewhat smaller teeth. Between these teeth and the base of the molar tubercle the part is twisted somewhat, and on the inner surface is a short outstanding process clothed with a double series of 8-10 short spines. The surface of the molar tubercle is slightly concave and square in outline, and the chitin is formed into numerous small parallel ridges.

The *right* mandible (Fig. 3) has the cutting edge consisting of only one row of four strong sharp teeth; on the inner surface, between these and the base of the molar tubercle is a slightly raised cushion, bearing three short, and one longer, stout spinules, and near these is a bunch of five pectinated spines. The right molar tubercle is somewhat longer than the left and the surface somewhat smaller, but in other respects is similar.

In use the cutting edge of the right mandible passes between the double row of cutting teeth of the left mandible, and in so doing incises the food, at the same time the molar tubercles meet together to act as grinders. From the figures this is difficult to comprehend on account of the difficulty of showing the twisted distal half, the shading of which would obliterate the details of structure.

*Lower Lip* (Fig. 5).—The lower lip is similar to *P. australis* consisting of two lobes, widely separate distally, but united proximally; and the ends are rounded, and they and the inner margins are densely fringed by inwardly pointing setæ, and the outer margins fringed by much shorter setæ.

*First Maxilla.* (Fig. 6).—The first maxilla agrees in outline with *P. australis* and consists of two parts, of which the outer is somewhat the longer and stouter; they both curve slightly inwards; the end of the *outer lobe* is truncate, and clothed with eight or nine pointed spines which gradually become shorter from

the outer side inwards. On the outer surface there are two positions bearing setæ, viz., at the base where there are about five, and towards the distal end about twelve. On the inner surface, midway between its union with the inner part and the distal end there are about five setæ. The *inner lobe* has its end somewhat rounded and bearing three long plumose setæ, and near the inner margin two single spines. Proximally on the inner surface there are a few short setæ, and along the outer surface are long setæ sparsely disposed, which point distally.

*Second Maxilla* (Fig. 7).—The second maxilla consists of a basal portion, produced at its inner distal end into a rounded elongate lobe. External to this articulate two lobes, similar to each other, which are slightly longer than the inner lobe and more slender. Along the inner face of the inner lobe are numerous long spinose setæ, pointing distally, gradually decreasing in length from the base upwards; on the rounded distal end are twelve or more long pectinated setæ. The ends of the two articulating lobes are obliquely truncate, with the face directed inwards, and bearing numerous long awl shaped pectinated setæ. The remainder of the lobes are unclotted.

Compared with *P. australis* the only marked difference is that the present species has the lobes relatively longer in respect to the base.

*The Maxillipedes* (Fig. 8).—Compared with *P. australis*, the maxillipedes are almost identical; they however bear slightly longer setæ, and the terminal joint is longer and more pointed. The *coxos* is short and irregular in outline; the *epipodite*, arising therefrom, bears, on the outer side, a large flat plate reaching beyond the end of the ischios; it is broadly elliptical in outline, with the margin entire. The *basos* is quadrangular, and about three times as long as broad. Joined to the inner margin of the basos for nearly its whole length, and running parallel with it, and situated at right angles to its upper surface, is an accessory flat plate, which leaves the basos proper near its distal extremity and extends beyond as far as the end of the meros, and terminates in a gradually narrowing and bluntly pointed end. In Fig. 8 this plate is turned on one side and pressed down, and therefore showing the inner lateral surface uppermost. Its dorsally situated margin, (right-hand side in figure) up to the end of the

basos proper, is clothed with fine setæ, and beyond this, and extending to the extremity, are long pectinated spines pointing distally on the lateral inner surface; between the basos proper and the free extremity, are three equi-distant "coupling spines." The *ischios* is short, transverse, and bears two or three setæ at the inner distal angle. The *meros* is subtriangular, the outer pointed distal extremity bears a few long curved setæ pointing distally, and the inner margin is convex, with five or six long straight setæ. The *carpus* is somewhat sunk in the meros, narrowed at the base, widens distally, and has the end truncate; the inner and outer margins are both convex, the former bears one or two curved setæ, and the latter is densely fringed, from end to end, with long outwardly directed setæ. The *propodos* is oblong, the outer margin sparsely setose, and the inner densely fringed with long setæ. The *dactylos* is of the same length as the propodos, but much narrower, bluntly pointed, and incurved. The outer convex margin is free from setæ, and the inner concave margin has a fringe of long setæ, and from the extremity arise about five long setæ, of similar kind and length to those of the inner margin.

*First Appendage of Pereion.*—There are two forms of the first appendage of the pereion found in adult males (*vide ante*), described hereunder as Normal and Hymeneal.

*Normal form of pereiopod of male and female.*—The normal form of the first pereiopod of the male is similar to that of the female, so that Fig. 9, drawn from the inner surface of an adult male, will illustrate both male and female. The basos and ischios combined measures slightly longer than the next three succeeding joints, the *basos* being somewhat the longer of the two. It is narrow at its articulation with the coxa, gradually widening to the proportion of two and a half times longer than wide, and again constricting distally; on the inner surface, near the distal margin, is a small tuft of long setæ; the anterior margin is sparsely setose. The *ischios* is of the same shape as the basos, but somewhat shorter and the anterior is sparsely setose. The *meros* is half the length of the ischios, and subtriangular in outline. The anterior margin is produced into a pointed projection, from the extremity of which arises a tuft of long spiniform setæ; the posterior margin is straight and sparsely setose; and

the distal margin is produced obliquely downward from the hinder to the front margin, and overlaps the junction with the carpus. The *carpus* is also subtriangular, the base of which forms the distal margin. The posterior margin is fringed with setæ. The *propodos* is oblong, in the proportion of its length being two and a half times the width, and its length measures two and a half times that of the two previous joints combined. The joint attenuates somewhat distally, and the anterior border in side view is curved from the proximal to the distal extremity, and is clothed in three places with a few long setæ. The posterior border is straight and forms a narrow palm, against which the dactylos, which articulates at the distal extremity of this border, can shut. Along the sides of the palm is a fringe of spiniform setæ. The *dactylos* is nearly as long as the propodos, slightly curved inwards, with the margin entire, and terminating in a strong sharp point. Along its inner margin are a number of very long filamentous setæ, and on the outer surface, near the distal extremity, is a small tuft of short sensory hairs, similar to form C previously described, and more proximally a few short setæ.

*Hymenial form of pereiopod of male.*—The only marked difference in the hymenial form is in the propodos and dactylos. Fig. 10 is a drawing of the inner surface of a smaller male than the preceding one, viz., 9 mm. The *propodos* will be seen to be much wider; the palm is slightly concave and there is a conical projection at its proximal end tipped with sensory hairs; there are no setæ on the convex anterior margin except at the extreme distal end. The *dactylos* is longer and more curved than in the normal form and tipped with a greater number of sensory hairs.

*Second, Third, and Fourth Pereiopods.*—The second, third, and fourth pereiopods are similar to each other (Fig. 11 is a drawing of the outer surface of the third and will sufficiently illustrate the other two). The *basos* and *ischios* are similar to the first pereiopod. The *meros* is sub-equal. The *carpus* is oblong and almost as long as the meros; the posterior margin bears a series of eight long stout spines, pointing distally, and from the antero-distal angle there is a tuft of long setæ like those in a similar position on the meros.

The *propodos* is subrectangular, of equal length to, but narrower than the carpus. About half the distance along the posterior margin there are two long spines, pointing distally; the anterodistal angle is tufted with long setæ, and the anterior margin sparsely setose.

The *dactylos* is short, slightly curved hindward, and ends in a strong pointed tooth; the posterior concave margin also bears a stout tooth, and the anterior margin is sparsely setose. The fourth pereopod is not modified to form a clasping organ as in *Phreatoicus*.

*The Fifth, Sixth, and Seventh Pereiopods.*—The fifth, sixth, and seventh pereopods are each similar in form to one another, but each is longer, and proportionately larger in all parts, than the immediately preceding one. The fifth is of equal length to the fourth, and the seventh is about one third longer than the first. (Fig. 12, drawn on a smaller scale than the first, illustrates the seventh, with the inner side uppermost). They each fit into a triangular emargination at the posterior limit of each segment, and are reversed in the manner of articulation to the preceding four appendages. Their appearance is so much like those of *P. australis* that a detailed description of them is unnecessary. In marked contradistinction the setæ of the present species is somewhat longer but not so numerous, and the terminal joint is not toothed.

*The Pleopods.*—The pleopods are all branchial in function, and the second pair, in the males, possess each a "penial filament" (Fig. 13). They are large and well developed, and hang from the ventral surface free from an operculum or any protective process. In fundamental features they are like *Phreatoicus* except in not having a distinct process in the third, fourth, and fifth pairs, thought by Chilton to be an epipodite, and also shown by Spencer and Hall to exist in *Phreatoicopsis*; and further, they are not protected by an extended pleura, as in the recorded species of the two mentioned genera. Each succeeding pair slightly diminishes in length hindward. The endopodite is in no case setose, and there are no plumose setæ on the exopodite as in *Phreatoicus*.

*First pair of Pleopods.*—In the first pleopod the *protopodite* is subrectangular in outline, with a tuft of long stiff setæ on the

inner surface, the outer margin is free. The *endopodite* unites with the protopodite just below the tuft of setæ; it is narrow—elliptical, with the margins entire, and the extremity rounded.

The *exopodite* unites with the propodite at its distal extremity, slightly below the junction of the endopodite. It is oblong, three times longer than broad, and somewhat longer than the endopodite, and reaches to about the level of the distal margin of the ischios of the seventh pereopod; the inner margin is straight and free from setæ; the upper margin is deeply convex, and the outer margin descends in irregular outline, gradually rounding off distally to form a bluntly pointed acute distal inner angle; along this convex margin there are long filamentous setæ sparsely disposed, but most numerous distally.

*Second pair of pleopods* (Fig. 13).—The *propodite* of the second pleopod is subequal to the first, but the inner and outer margins are deeply convex. The *endopodite* is not so long, and is joined to the propodite by a thick peduncle, from which, in the male, arises the penial filament. This is a narrow somewhat curved process, gradually tapering to a point, slightly constricted at its proximal end, and reaching to below half the length of the endopodite; its inner surface is deeply grooved longitudinally.

The *exopodite* is similar in general outline to that of the first, except that towards the distal end a jointed small narrow lobe arises from an emargination in the inner margin, situated a short distance below the level of the distal extremity of the endopodite, and hangs vertically downward along side of, and parallel with, the continued inner margin of the large basal lobe, and extending somewhat below it; the inner margin of the large lobe is thickly fringed with short setæ as far as the insertion of the small lobe, and from there to the extremity it is bare; the margin of the small lobe which appears as a continuous line with the inner margin of the large lobe is similarly fringed with short setæ, which gradually lengthen distally, and continue along its rounded extremity. The distal margin of the large lobe bears a few long filamentous setæ, and on the upper half of the outer convex margin there are longer filamentous setæ, somewhat thickly disposed, and between these two regions there are a few short scattered setæ; also over the flat surface of the lobe there are a few irregularly scattered setæ. In the *female* the appendage is similar in form except in not having a penial filament.

*Third, Fourth and Fifth pairs of Pleopoda.*—I shall describe these together. The *propodite* of each is subequal in shape to the preceding one with the addition of a swelling on the inner surface of each, which is most marked on the third, appearing there as a bluntly rounded prominent tubercle clothed with short setæ. There is no so called epipodite, as shown by Chilton to exist in *Phreatoicus*, and also by Spencer and Hall in *Phreatoicopsis*.

The *endopodite* of each is broader and shorter than the second, the fourth is shorter than the third, and the fifth very much shorter than the fourth. In other respects they are similar to each other. The *exopodite* of each becomes gradually broader and shorter than its antecedent, but in general contour and disposition of setæ they are similar to the second. The accessory lobe in each becomes shorter in a similar way and degree as in the endopodites.

*The Uropoda* (Fig. 14).—The *uropoda* point distally and are very strongly developed. The peduncle stretches considerably beyond the end of the telson; its lower margin is straight and sparsely setose, the upper margin is bluntly serrated, and bears a few short setæ. The *outer ramus* is equal in length to the peduncle, and arises from above the insertion of the inner ramus; in shape it is styliform, terminating in a strong acute point, at the base of which arise, on the upper and outer surfaces, numerous very long spinose setæ, which project backwards and outwards. The *inner ramus* is similar to the outer one except in being slightly longer and curving inwards so as to cross the inner ramus of the other side.

*Gravid Female.*—In a female, with fully developed incubatory pouch, measuring 12 mm. long, the pouch occupies an area under the first to the fifth free segments of the pereion, and reaches ventrally to near the distal extremity of the ischios of the third pereopod. In outline the anterior, posterior, and ventral margins are deeply convex. It is formed of three pairs of thin transparent lamellæ (oostegites) produced from the inside of the basal joint of the antipenultimate and succeeding two pairs of pereopods, which overlap each other along the lateral borders, and incurve ventrally to overlap those of the opposite side, and so form a spacious pouch, containing about twenty light yellow-

coloured eggs. The lamellæ are each subspherical in outline, with margins entire.

*Sexual differences.*—The only external differences in the form of the female from the hymeneal male are that the first pereopod, which is similar to that of the normal male, has not the largely developed clasping hand characteristic of the hymeneal form; there is no external male organ at the base of the seventh pair of pereopods, and no penial filament on the second pair of pleopods, and when breeding there is a specially developed pouch.

*Generic position.*—The nearest ally to the present species is *Phreatoicus australis*, and, compared with that species, there is no great difference in the head and pereion and their appendages, except that in the present species the pereion is relatively much more slender, but in the truncated telson it more nearly resembles *Phreatoicopsis terricola*. The difference however in the pleon, both in its relative length, which is short, and in the pleura being unproduced, mark it off from either of the above genera, and make it necessary to form a new one for its reception.

The measurement of a number of different individuals of the present species showed an invariable degree of comparison between the length of the pleon and telson to that of the cephalon and pereion, and herewith I append the proportions of other allied forms, which I measured from the drawings of Chilton, and Spencer and Hall. Taking the cephalon and pereion combined as 100, then the pleon and telson combined measured in the following species as under:—

Phreatoicopsis gracilis	-	-	-	$\frac{36}{100}$
Phreatoicus australis	-	-	-	$\frac{58}{100}$
„ assimilis	-	-	-	$\frac{61}{100}$
„ typicus	-	-	-	$\frac{63}{100}$
Phreatoicoides terricola	-	-	-	$\frac{60}{100}$



DESCRIPTION OF PLATES.

PLATE X.

- Fig. 1.—Side view of *Phreatoicoides gracilis*.  $\times 11$ . (The terminal segment has been mistakenly transcribed; the uropod should not articulate with the anterior margin, but with the postero-distal margin as shown in Fig. 14).

PLATES XI. AND XII.

- Fig. 2.—Upper lip.  $\times 42$ .  
,, 3.—Mandible of right side.  $\times 42$ .  
,, 4.—Mandible of left side.  $\times 42$ .  
,, 5.—Lower lip.  $\times 42$ .  
,, 6.—First maxilla.  $\times 42$ .  
,, 7.—Second maxilla.  $\times 42$ .  
,, 8.—Maxillipede seen from above.  $\times 42$ .  
,, 9.—First appendage of pereion. Normal form of male.  
 $\times 42$ .  
,, 10.—Portion of first appendage of pereion. Hymeneal  
form of male.  $\times 42$ .  
,, 11.—Portion of third appendage of pereion.  $\times 42$ .  
,, 12.—Portion of seventh pereopod.  $\times 35$ .  
,, 13.—Second pleopod of male.  $\times 32$ .  
,, 14.—Terminal segment.  $\times 40$ .
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